The film samples of Comparative Cases 1 to 4 and those of Example 1 of the invention were prepared, in which the thickness of the free layer of NiFe was varied for the varying Ms×t. The film samples of Example 2 were prepared by varying the thickness of the free layer of CoFe. All the samples were thermally annealed at 270°C for 10 hours in a magnetic field of 7 kOe, and their data were measured.

In Comparative Case 2 and Examples 1 and 2, the high-conductivity layer is of Cu, having a thickness of 2 nanometers. The points of Ms×t in the free layer as indicated by the arrows in Fig. 16 are for the films (1) to (4) of Comparative Cases mentioned above. For the Ms×t in the free layer in all samples, Ms of NiFe is 1T and Ms of CoFe is 1.8T. All the free layer thickness are expressed in terms of thickness with Ms of 1 Tesla.

In the films of Comparative Cases 1, 3 and 4 where no high-conductivity layer is provided on the free layer, MR ratio is greatly lowered with the reduction in Ms×t in the free layer. These films could hardly ensure high output capable of satisfying high-density recording.

In the film of Comparative Case 2 having a high-conductivity layer, the free layer Ms×t dependence of the MR ratio is relatively small. However, since the antiferromagnetic layer in this film is of FeMn, not containing a noble metal, the thermal stability for MR ratio in thermal

treatment is low. With such small MR ratio, the film could not ensure high output for high-density recording.

In the films of Comparative Case 2 and Comparative Case 3, if a layer of Co or CoFe having a thickness of 0.5 nanometers is inserted between the spacer of Cu and the free layer of NiFe, the MR ratio will increase by 1 to 2 % above the data in the graph of Fig. 16. Even if so, however, the Ms×t dependence of the MR ratio is still the same as that in the single-layer NiFe free layer. Anyhow, small MR ratio will do well in the region where Ms×t in the free layer is small.

On the other hand, in the films of the invention where a high-conductivity layer is provided adjacent to the free layer and the antiferromagnetic layer contains a noble metal, the thermal stability for the MR ratio after thermal treatment is good. The films of the invention produce high output well applicable to high-density recording. In particular, the difference in the MR ratio between the films of the invention and those of Comparative Cases is obvious in the region where Ms×t is smaller than 5 nanometer Tesla.

The magnetoresistance effect device of the invention is described in detail hereunder.

Fig. 1 is a conceptual view showing the sectional constitution of the magnetoresistance effect device of the invention. As illustrated, the magnetoresistance effect device of the invention comprises a high-conductivity layer

101, a free layer 102, a spacer layer 103, a first ferromagnetic layer 104, a coupling film 105, a second ferromagnetic layer 106 and an antiferromagnetic film 107, all laminated in that order.

In the device with that constitution, the free layer 102 is much thinned. On the transfer curve where Hs is small due to ultra thin free layer, Hcu, Hpin and Hin are all small Hpin - Hin = Hcu, and a good bias point can be realized in the device. In general, in ultra-thin free layers, high MR ratio is difficult to realize. The device of the invention has overcome this problem. The device has good thermal stability for MR ratio, and therefore can realize high-output heads.

Specifically, even though having the ultra-thin free layer for high-density recording, the spin valve film constitution of the invention can realize good bias point and can maintain high MR ratio. Therefore, the film stably produces high output. Concretely, in bias point designing, the condition of Hpin - Hin = Hcu is realized, and the film has good bias point. Reducing all Hpin, Hin and Hcu is important for stably realizing the condition of Hpin - Hin = Hcu.

Regarding Hpin, the film has a so-called Synthetic AF structure where the two ferromagnetic layers are antiferromagnetically coupled to each other. In this, therefore, Hpin is derived from only the difference in the